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PLANNING OF THE MODERN AIR BASE

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PLANNING OF THE MODERN AIR BASE

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Many of our military airfields were hastily built during World War II, and I doubt whether sound, coordinated planning was put to use. It is quite conceivable that the General Staff or the Commanding Officer had varied ideas of how an airfield should be laid out and how it should function. Consequently, an inefficient layout resulted. Generally speaking, the airfields lacked comprehensiveness, continuity, and flexibility. The belief prevailed that as long as there were runways, taxiways, and an apron, we had an airfield. Until about the year 1947, the installations grew like "Topsy." Whenever a new structure was programmed, it was sited wherever an open area was available, and little thought was given to the functional relationship between buildings or areas.

There apparently was a standard runway layout for an installation. Many of the bases that were built had as many as five runways, each with a different bearing. To accomplish the orderly expansion of a base, it has now become necessary to close some of these "third, fourth, and fifth" runways. I know of an existing air base in this country where a "split operation" has resulted because of a lack of planning during the initial development of the base. A "split operation" base is described as a base that has major functions divided by one or more runways. The air base I have in mind has all of the warehousing and engineering facilities separated from the operations and maintenance area by more than one mile. A development of this kind restricts administrative control and results in an impractical and costly means of support.

Today, we have the difficult task of applying new criteria and vastly different requirements to an outmoded flying field. The developers of the World War II airfields never contemplated the conversion to jet operation which calls for runway lengths of 10,000 feet or better. Many of the fields built during World War II cannot be expanded to meet current runway lengths, because of being bounded by State and Federal highways, main trunk rail lines, rivers, etc. In some instances, major highways have been relocated at a great expense to allow for runway extension.

The development plan of a new installation must be based primarily upon the principles of sound land planning. Efficiency and safety of operations, as well as economy of construction, are the prime considerations in planning an installation. Such planning demands complete knowledge of the functions of the installation, broad vision, a thorough knowledge of terrain and its adaptability and use in the proper functional adjustment of buildings or groups of buildings to the land and to each other. The installation must be planned with a knowledge of maximum flexibility of use and future expansion. Topography of the site, soil conditions, topography of approach zones and flight zones, structures in the approach zones, existing highways and railroads are factors that must be thoroughly reviewed.

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To begin the planning of a modern air base, we will assume that the Government has purchased an undeveloped area comprising approximately 2,000 acres. The land requirement is determined by criteria which specifies runway lengths and the areas required for the supporting facilities and housing. We will also assume that the mission for the base will be two medium bomber wings. The medium bomber is the familiar B-47 Stratojet, which General LeMay of Strategic Air Command describes as a magnificent fighting ship.

The military installation, which has some of the same characteristics as a city, is an integral part of the region in which it is located. Matters of mutual regional interest, such as housing, traffic, transportation, utilities, supply routes from nearby cities and towns, railroad centers and airports, and recreation facilities must be discussed with Federal, State, County, and local planning authorities. Meetings are held with CAA representatives to secure information regarding antenna tower installations or other high structures being constructed or proposed by commercial or other interests. These structures, because of their height and/or location, may become hazards to aircraft operations and may interfere with the initial operations or expansion of the installation. Criteria relating to the location and height of such structures is clearly established by controlling Government agencies. Existing air traffic control and/or flight pattern information is also evaluated. Existing flight patterns of military bases and civil airports have in some cases completely nullified the utilization of existing runways at inactive bases that could be developed in some future Air Force expansion program.

With data compiled by the Weather Service is reviewed for the purpose of determining prevailing winds. For our medium bomber mission, the runway or runways should provide a minimum wind coverage of approximately 90 per cent. The number of runway directions required from a wind standpoint is based on the maximum cross-wind in which aircraft may be safely operated. A maximum cross-wind has been established as 13 miles per hour. This is measured by the beam wind component, which is that component of any wind which acts perpendicular to the runway axis. As an interesting sidelight, I would like to mention that the swept-back wing of the B-47 causes a greater need for flying into the wind. At several Zone of Interior installations, wind coverage permits operations to be carried out with but one active runway. The use of administrative aircraft, such as the C-45 and C-47, will generally demand a second runway in areas where high-velocity cross-winds occur.

In determining runway lengths, altitude and average maximum temperature of the location are considered, together with the weight of the aircraft, take-off run, and landing roll. A factor of safety of 1.75 is applied to the ground roll for all aircraft missions, except a training mission, where a factor of 2.0 is used. The assumption will be made that criteria factors indicate that the mission we are concerned with requires a primary runway of 10,700 feet in length and 200 feet in width. Based on wind data, expansion potentiality, and topographic surveys, this runway will have a north-south orientation. Clear zones of 1,000 feet in length by 1,500 feet in width, immediately adjacent to runway ends, are cleared areas and graded level so as not to cause serious damage to any aircraft which may over-shoot or over-run the runway. The taxiway width will be 75 feet.

In areas of heavy snow, consideration must be given to provide space for snow removal on runways, taxiways, and aprons. This problem is handled by providing islands for snow storage. In the winter of 1952, snow was piled

from 16 to 20 feet deep along the runways and taxiways of one of the far north installations.

The airfield proper will consist of a system of runways, apron and taxiways which connect the apron and the runways. At each end of the runway, a warm-up pad will be provided. Closely related to the airfield proper are certain facilities such as airfield lighting and landing aids. In connection with the landing aids, many technical facilities are now being used by the Air Force to minimize the dangers of landings and take-offs under bad weather conditions.

The landing facilities can be most easily classified into two categories: (a) radio; (b) radar. Typical radar landing facilities are the Tactical Ground Control Approach, nicknamed the CPN-4, the Airport Surveillance Radar, referred to as the CPN-18, and the Fixed Ground Control Approach, commonly known as the FPN-16.

A typical radio facility used in the landing procedure of aircraft is the Instrument Landing Approach System, commonly known as the ILAS. The ILAS is generally made up of five units: an outer marker, inner marker, and middle marker; a localizer, and a glide path indicator. The function and siting of these facilities is, as follows: The outer marker is located approximately 5 to 8 miles from the approach end of the instrument runway. The middle marker is located approximately 2-1/2 miles from the approach end of the instrument runway; and the inner marker, or boundary marker as it is sometimes called, is located within 2,000 to 3,000 feet of the approach end of the runway. These 3 facilities emanate radio waves in a fan-shaped vertical direction. The localizer facility is normally sited 1,000 to 3,000 feet from the opposite end of the approach to the instrument runway. The localizer issues radio waves which correspond to the glide angle of the plane's approach. The glide path indicator, the fifth of the units, is sited 250 to 350 feet off to the right of the approach end of the instrument runway, approximately 500 feet from the localizer. The radio waves emanating from this facility control the horizontal direction of the plane. The line of intersection of the radio beams given out by all these five facilities is a line of descent that the pilot should take for a satisfactory and safe landing. Instruments in the aircraft reveal the glide path position. During the approach procedure, the pilot is in complete command of the plane.

Recently, the Sperry Gyroscope Company has developed a facility somewhat similar to this ILAS facility, but instead of the pilot having to guide the plane all the way in, an electronic device in the airplane seeks the localizer path out and follows it. The airplane then switches to the glide slope automatically and holds the true glide track against all deflecting forces until at the last minute, just before the wheels touch the ground, the pilot must take over.

The prime function of an airfield is to carry out a flying mission; therefore, the next step in the design of the base will be the siting of facilities related to flying and maintaining the aircraft. The ramp or apron is the paved area required for parking of aircraft in operational status and is also used for parked aircraft that are being serviced, inspected, or repaired. Expansion of the apron area should be feasible on at least one end. It is desirable to locate the operational part of the apron parallel to the primary runway, or the runway that carries the greatest amount of traffic. Such an apron arrangement shortens the amount of taxiing required by the aircraft and permits complete observation from the control tower. Fueling hydrants are sited on the apron so that refueling and defueling becomes an integrated

part of the parking procedure for the aircraft immediately before and after mission assignments.

Apron parking requirements are determined by the size and maneuverability of the aircraft and the jet blast area. Experience has shown that for the medium bomber parking requirement, an apron width of 1,155 feet is optimum for safety and maneuverability. Based on a recently conducted investigation on aircraft parking procedures, including a study of safety requirements imposed by blasts from jet engine aircraft, it has become necessary to increase the factor used in computing the parking apron area, thereby materially increasing the requirement for paved areas at an installation.

The technical or industrial area which contains the buildings and facilities required for the proper and efficient direction, control, maintenance, and repair of the aircraft, is located immediately adjacent to the apron, along the operations "line." This area is made up of the base and squadron operations building, hangars, nose docks, shops, crash and fire station, training aids building, etc. These back-up facilities that are required to keep the aircraft flying must be efficiently sited to attain a proper relationship of functions.

The functioning of a control tower, which is a part of the base operations structure, is an important factor in the relative locations of technical buildings, particularly the hangars. The control tower is located so that aircraft on all runways, taxiing lanes, and in the immediate vicinity of the airfield will be visible under normal atmospheric conditions. No construction which will interfere with the unobstructed vision from the control tower will be permitted. For reasons of safety and operational efficiency, the line facilities just mentioned are sited along a line 125 feet from the back edge of the apron area.

The maintenance hangars, which are expansible double cantilever structures with ground floor area of 94,000 square feet, house the aircraft that undergo major repairs. Whenever possible, these hangars are centrally located along the apron line rather than near the ends. A central location is advantageous to the maintenance crews with regard to movement of supplies and aircraft parts. A base maintenance shop sited immediately adjacent to the hangars is made up of individual shops for repair of tires and wheels, batteries, propellers, instruments, etc. Also housed in the maintenance shop are areas for sheet metal work, electric plating, camera repair, and woodworking.

The wing hangars, which are abbreviated maintenance hangars, and nose docks are used for minor repairs. Minor repair work is accomplished by maintenance crews which are assigned to the individual tactical squadrons. Recently a decision was made in the interests of economy that nose docks would be used exclusively at all air bases located in the South. Squadron operation buildings and maintenance shops which serve the tactical units are located directly to the rear of wing hangars or nose docks.

Warehouses, open storage areas, and reclamation and salvage yards are located to minimize the amount of construction required for railroad spurs and access roads. In an ideal situation, railroad spurs and access roads will by-pass the built-up areas and avoid passage through runway clear and approach zones. In many cases, it is advisable to locate the warehouse areas adjacent to, or as an integral part of, aircraft maintenance and repair shops and within the prescribed distance from the main crash and structural fire station. The Installation Engineer Office and related shops along with the base motor pool are also located adjacent to the technical area.

Principal facilities which make up the administrative hub of the base are,

as follows: wing headquarters, air base group headquarters, training group headquarters, and tactical group headquarters. These buildings are located as closely as possible to the technical and training areas, and if possible, along the main entrance road. A maintenance and supply group headquarters is sited in the warehouse area.

Training facilities, such as the high-altitude training building and technical training classrooms, to mention a few, are generally located near the operations and troop housing area.

The combined crash and fire station is strategically located along the building line of the apron, where it can serve the entire installation. Maximum visibility is essential so that responses to both the airfield and building area is unobstructed. Fixed distances are established as guides to maximum fire response from the fire stations. As an example, a maximum distance of one mile is established for hangars, shops, and other technical facilities and warehouses. A maximum distance of five miles is established for individual family dwellings. To meet the fixed distances, two additional structural fire stations may be needed to serve large installations.

It is always highly desirable to develop a community area for the use of the assigned personnel. These community centers are generally made up of the following facilities: chapel, theater, gymnasium, post exchange, hobby shop, post office, and in some cases, the commissary. The grouped facilities of the communal area should be located within walking distance of the airmen dormitories and conveniently accessible to the family housing areas. It is important to avoid locating the community center where the vehicular and foot traffic may congest and interfere with traffic concerned with the technical activities of the installation.

Not too many years ago, most of our troop housing was located almost adjacent to the line, because the planner was striving to keep the airmen conveniently close to the duty areas. With the conversion to jet operations, it became necessary to revise existing planning criteria. Due to the volume of noise in jet operations, Air Force criteria now specifies that where space permits, housing areas should be a minimum of 1,800 feet from the line area. The two-story permanent type airmen dormitory houses approximately 200 men. Four of these dormitories are grouped around the mess or dining hall. In the southeast, living quarters are oriented to take advantage of prevailing breezes.

Parking areas consume relatively large spaces from an area standpoint. Area allotments are based on studies that indicate that 100 per cent of the officers and 60 per cent of the airmen own automobiles. A traffic count at Eglin Air Force Base revealed that approximately 9,000 cars entered the installation on a given day.

Today, a great many of us are aware of jet aircraft flying over business and residential areas. We seek out the location of the plane by the "screeching" sound. There are various psychological effects of jet noise, but in due time, personnel on a base seem to get used to it, but whether civilian neighbors get used to it is another question. If any of you have visited a base where jet aircraft operate, you will know that the noise can be very disturbing. The general public in some areas is apparently quite disturbed by the operation of jet aircraft.

An article in the September issue of Aviation Age relates that airport authorities are in for some trouble when jets are used on commercial routes. The article states that a retired Pittsburgh lawyer has been "annoyed" by the noise of airline planes passing over his house and has taken

his troubles to court. The old gentleman claims that the aircraft have disturbed his sleeping and waking hours. When the Pittsburgh lawyer was told that only a fraction of one per cent of all landings and take-offs are now made over his home, he said, "It's that fraction that keeps me awake."

The Air Force has found a necessity for providing family housing at installations, because it has discovered that the morale of the airmen is greatly improved when it is possible for him to live with his family. The family housing areas are located away from the industrial and technical areas and are separated from the troop housing areas by buffer zones of recreational fields. Criteria for allocation of space in housing areas is as follows: 100 airmen per acre for airmen housing; four to five families per acre for officer family housing, and six to seven families per acre for NCO family housing. For recreational areas, 12 acres per 1,200 men. Those of you who have seen Wherry Housing projects at military installations will know that there are very few instances where the optimum family housing density of four to five families per acre has been met. Monetary limitations and excessive real estate costs prohibit this.

The base hospital is located so that it is easily accessible by direct route from all areas of housing. Noise areas of runways, apron, motor pools, and service roads are avoided. Further consideration is given to proper location with respect to prevailing winds which may carry dust, disagreeable odors, and smoke from such areas as the parade fields, heating and power plants, and sewage treatment plants. Approximately 15 to 20 acres of land is desirable for a 150-bed hospital site. Other medical facilities, such as the dental clinic and the dispensary are located in the work areas for the convenience of the assigned personnel.

The aircraft gasoline storage areas which are located sufficiently distant from other areas to provide for expansion in storage facilities and to provide fire safety zones are adjacent to the railroad spur or an access road over which gasoline is supplied. Other storage facilities, as solvents, hydrogen, oxygen, and hazardous chemicals, must be located to minimize the introduction of severe hazards and exposure to other facilities.

Ordnance areas are located in accordance with Air Force regulations and require extensive protective easements to meet safety requirements. The igloos which house the required mission explosives are barricaded and constructed with reinforced concrete, yet Air Force criteria requires that buildings occupied by personnel be separated from the nearest point of explosives by as much as 3,375 feet. These quantity-distance standards compel the Government to purchase large tracts of land. Recently, our office processed a real estate planning report covering a requirement for 820 acres, which is in excess of one square mile.

Road patterns are pretty well worked out by the grouping of the various functional areas and in the formation of circulation between these areas. It is believed that wherever possible a rigid grid pattern of streets should be avoided. A design of small rectangular blocks is neither economical nor desirable. The development of a pattern of superblocks in the technical, administrative, training and troop housing areas will result in the creation of a unified and orderly arrangement of land use.

I have mentioned only the major functions that make an Air Force installation tick. Numerous secondary facilities have not been mentioned, nor have I gone into the details of airfield zoning and avigation easements, which are also of concern to the planner. The air base plan of today, which stems from good planning and engineering principles, is bound to provide the Department of Air Force with a most efficient and economical guide for long range development.